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IT Innovativeness and Environmental Consciousness on Organizational Performance

Myung Ko

The University of Texas at San Antonio

Department of Information Systems and Technology Management

One UTSA Circle, San Antonio, TX 78249

Phone: 210 458-6339, Fax: 210 458-6305

Myung.ko@utsa.edu

Jan Guynes Clark

The University of Texas at San Antonio

Department of Information Systems and Technology Management

Jan.clark@utsa.edu

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Phone: 210 458-6339, Fax: 210 458-6305

Myung.ko@utsa.edu

Jan Guynes Clark

The University of Texas at San Antonio

Department of Information Systems and Technology Management

Jan.clark@utsa.edu

Daijin Ko

The University of Texas at San Antonio

Department of Management Science and Statistics

Daijin.ko@utsa.edu

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ABSTRACT

The purpose of our study is to investigate the impacts of Information Technology (IT) innovation and environmental consciousness on firm performance. We tested the robustness of innovation theory using the most recent Information Week (IW) 500 annual datasets. As expected, performance of IT innovators was better than their industry average performance. However, performance of environmentally conscious IT innovators is frequently no better than that of less conscious IT innovative firms. And, for some performance indicators, less environmentally conscious IT innovative firms out-performed more environmentally conscious IT innovative firms.

KEYWORDS: Information technology (IT) innovation, firm performance, organizational innovation, IT role, environmental consciousness, and environmental performance

INTRODUCTION

Organizations have continuously increased their investments in information technology (IT), hoping to create value (Kohli & Grover, 2008; Hu & Quan, 2006). However, researchers (Shin, 2007; Zhuang, 2005) have reported that IT investments alone do not add value to the organization. Instead, emphasis should be placed on how the IT investment is used within the organization. In fact, the *InformationWeek (IW) 500* annual survey selects the top 500 most innovative U.S. firms based on innovation in business technology, not on the biggest IT investments. IT investment is considered innovative if it represents the first use of a technology among firms in the same industry, or if it results

in a new product or service (Dos Santos et al., 1993). Daft (1978) defined organizational innovation as "the adoption of an idea or behavior that is new to the organization adopting it" (p.197). Thus, organizational innovation leads to organizational changes, which become a driving force for improving organizational performance and achieving competitive advantage (Swanson, 1994; Damanpour & Evan, 1984; Tucker, 2002).

IT innovativeness is an important contributor to organizational success. However, organizations that invest in innovative technologies are faced with increasing cost and complexity associated with a decreased technology life cycle (Xu et al., 2007). If they invest in the technology, costs and complexity increase. Yet, if they do not invest in the technology, they run the risk of losing out to the companies that do invest (Geisler & Kassicieh, 1997). Prior studies (Zhuang, 2005; Bharadwaj, 2000; Santhanam &Hartono, 2003) have shown that IT innovative firms outperform less innovative firms. However, these studies were based on time periods between 1991 and 2001, which were times of global economic growth and performance (Harchoui, et al., 2002). Since then, economic growth in the United States has been lower than the last half of 20th century and most firms have experienced minimal growth (Morrison, 2006).

With increasing pressures from various stakeholder groups in recent years, some organizations have devoted time and resources beyond the firm's interests and legal requirements toward protecting the environment and promoting corporate social responsibility (CSR). As a result, there is a need to measure the performance of firms with respect to the environment. Although the effect of environmental performance on

profitability has increased over the last few years, the results of previous studies are largely mixed. Some research indicates no relationship (Ullman, 1985; McWilliams & Siegel, 2000) while others indicate either a positive (Cornell & Shapiro, 1987; Klassen & McLaughlin, 1996), or a negative relationship (Judge & Krishnan, 1994; Walley & Whitehead, 1994). Thus, this leaves us wondering if it pays to "go green."

The purpose of our study is to investigate the impacts of information technology innovation and environmental consciousness on firm performance. Prior studies have shown that during periods of economic growth, IT innovative firms outperform other firms in their industry sector. However, does this hold true during periods of minimal growth or economic decline?

We also explore whether environmentally conscious IT innovative firms perform better than those that are less environmentally conscious. Although the number of companies attempting to achieve higher profits with a greener corporate image has increased (Magness, 2007), little research has been done on this topic. This lack of empirical evidence provides motivation for our study. This study is expected to be beneficial to IS researchers and business managers who are facing increasing competition to know if it pays to "go green." In this study, we examined the performance of IT innovator firms by comparing their financial performance with industry average performance. We next reviewed various web sites and other environmental performance categories to determine each IT innovative firm's level of environmental consciousness.

ORGANIZATIONAL INNOVATION

Innovation can be characterized as either administrative or technical innovation (Damanpour & Evan, 1984; Damanpour et al, 1989; Wolfe, 1994). Although there is no clear-cut difference between the two (Zmud, 1983), administrative innovation is primarily based on the needs of management and indirectly influences the process of producing products or services and enhances organizational coordination and organizational efficiency. Conversely, technical innovation has a direct influence on the firm's product or service, makes an organization more competitive in the market, and is an important factor for organizational effectiveness (Damanpour & Evan, 1984; Damanpour et al, 1989; Subramanian & Nilakanta, 1996).

Based on the premise that organizational innovation is increasingly important to stay competitive and become successful (Swanson, 1994), previous studies have investigated the relationship between organizational innovation and firm performance. To measure IT innovation, Shin (2007) developed a second-order construct from technology strategy, e-business strategy, business practices, and customer knowledge. He found that IT innovation had a significantly positive role on firm performance, as measured by Tobin's q and revenue per employee. However, his study did not show any significance on return on assets (ROA). Zhuang (2005) also examined the relationship between IT innovation in electronic business and firm performance and concluded that e-business innovativeness positively impacted firm performance and thus, innovative firms gained competitive advantage.

In line with Schumpeter's Innovation Theory that focuses on value creation, the resource-based view (RBV) of IT suggests that a firm's specific resources and capabilities lead to value creation (Amit & Zott, 2001). Based on the RBV framework, Bharadwaj (2000) investigated the relationship between superior IT capability and firm performance and found that firm performance of the IT leaders was significantly higher than that of the matching sample firms. However, contrary to expectations, the selling and administrative expenses-to-sales ratio (SGA/S) of the IT leaders was higher than that of the control firms.

Recently, Santhanam and Hartono (2003) partially replicated the work of Bharadwaj (2000) and investigated the link between IT capability and firm performance. They used the same data source and time period as Bharadwaj (2000) and also employed matched sample comparison. They matched firms by industry and found that firms with superior IT capability had better performance, even after adjusting for prior firm performance. Previous studies (Brown & Perry, 1994) have suggested that a "halo effect" exists if the selection of IT innovators is heavily influenced by prior financial performance. Both Bharadwaj (2000) and Zhuang (2005) tested the halo effect and concluded that it did not exist. Table 1 summarizes the previous IT innovation and firm performance studies.

Table 1. Review of Previous IT Innovation Studies

Study	**Period Studied (Sample Size)**	**Methodology**	**Key Findings**
Bharadwaj (2000)	1991-1994 (56)	• Matched sample comparison (used a single control firm matched by industry and similar in size)	The firms with high IT capability outperformed the control firms.
Santhanam	1991-1994 (56)	• Matched sample	The firms with superior IT

Study	Period Studied (Sample Size)	Methodology	Key Findings
& Hartono (2003)		comparison (used all firms in the same industry)	capability show higher current and sustained firm performance, even after adjusting for prior firm performance.
Zhuang (2005)	1998-2001 (62)	• Matched sample comparison (used all firms in the same industry)	The performance of e-business innovative firms is significantly higher than that of control firms.
Shin (2007)	2000-2001 (453 to 508 depends on variables)	• OLS Regression/ factor analysis	IT innovation is positively related to firm performance as measured by Tobin's q and revenue per employee but not by ROA.

Previous firm performance studies were conducted on *Information Week* (IW) data from years 1991- 1994 and years 1998-2001. Thus, considerable time has passed, and organizations have probably made major changes in their use of technology innovations. In this study, we used more recent *InformationWeek* 500 annual reports for the years from 2001-2006 and tested the robustness of Innovation Theory. Note that for comparison purposes, we used the same metrics as previous studies (Zhuang, 2005; Bharadwaj, 2000; Santhanam & Hartono, 2003).

ENVIRONMENTAL CONSCIOUSNESS

Environmental issues have received increased attention at the company level. This is mainly due to the growing demand for environmental management from government regulators, consumers, and the general public (McWilliams & Siegel, 2001). Consumers tend to associate terms such as "environmentally friendly" with product quality (Creyer & Ross, 1997) or as a measure of the company's concern for the consumer and society (Kang & James, 2006).

International regulations such as the Montreal Convention and Kyoto Protocol (Chen, 2007) also play an important role in corporate awareness of the need to address environmental issues. Release of the ISO 14001 standard for environmental management in 1996 (later revised in 2004) also indicates a global consciousness of environmental issues (Motabon et al., 2007; Price, 2007). The ISO 14001 standard was initiated to help organizations take a more pro-active approach toward protecting the environment while reducing the negative impact that their business activities have on the environment. Its aim is to help reduce and minimize an organization's impact on the environment. This is often referred to as environmental performance (Link & Naveh, 2006; Klassen & McLaughlin, 1996).

In contrast to the traditional economic argument, Porter (1991) and Porter and Van der Linde (1995) view "going green" as a win-win proposition for both the environment and the firm. While the environment improves because of regulated and/or self-regulated efforts, the organization also improves. If the environmental standards are properly designed, firms find innovative ways to use materials more productively and thus enhance or maintain competition (Porter & van der Linde, 1995; Klassen & McLaughlin, 1996).

Using an event methodology, Klassen & McLaughlin (1996) investigated the impact of the public announcements of firms that win environmental awards or experience environmental crises on a firm's stock market returns. The authors found that the firm's

strong environmental management, as indicated by environmental performance awards, is associated with significant positive returns in market value. Using a survey method, Melnyk et al. (2003) investigated the impact of environmental management systems (EMSs) on organizational performance and found that EMSs have a strong positive impact on operational performance. As with previous studies, Montabon et al. (2007) explored the relationships between environmental management practices (EMPs) and firm performance measures and also found that EMPs were positively associated with firm performance.

Other researchers argue that improving environmental performance leads to a drastic increase in cost without any economic payback. This leads to reduced profits, decreased returns to stockholders, and thus, hindered organizational competitiveness (Walley & Whitehead, 1994).

Price (2007) surveyed 405 organizations in the United Kingdom that were registered with the European Union's Eco-Management and regulated by Audit Scheme (EMAS) and the UK's Control of Major Accident Hazards (COMAH). Of the 109 organizations responding, 70% had obtained ISO14001 certification. Although many organizations reported benefits from ISO 14001 certification, only 9 reported any financial benefit. Although profit remains the primary reason for most firms' existence, they are increasingly more conscious of their corporate social responsibilities, such as environmental management. Firms that intentionally disregard environmental issues face the risk of decreased profits due to such factors as governmental fines and lack of

consumer confidence. However, environmental management is an expensive, long-term process. Although it is expected that environmental consciousness pays off in the long run, how much effort are firms willing to expend in this effort, and do they receive a return on their investment?

IMPACTS ON FIRM PERFORMANCE

We formulated the following hypotheses, based on their proposed impact on firm performance.

IT Innovative Firms

Organizational innovation theory suggests that IT innovation is a key factor in improving firm performance. Our study includes the sample of IT innovative firms. We measured firm performance based on five profit ratios and two cost ratios, as used in the previous studies. The ratios and their formulas are shown in Table 2.

Table 2. Description of Financial Performance Measures

Profit Ratio	**Formula**
Return on Assets (ROA)	Net Income / Total Assets
Return on Sales (ROS)	Net Income / Net Sales
Operating Income to Assets (OI/A)	Operating Income before Depreciation / Total Assets
Operating Income to Sales (OI/S)	Operating Income before Depreciation / Net Sales
Operating Income to Employee (OI/E)	Operating Income before Depreciation / Employee
Cost Ratio	**Formula**
Cost of Goods Sold to Sales (COGS/S)	Cost of Goods Sold / Net Sales
Selling & Gen. Admin. Exp. to Sales (SGA/S)	Selling & Gen Admin. Expenses / Net Sales

Based on organizational innovation theory and prior research, we propose the following hypotheses:

H1a: IT innovative firms have higher profit ratios when compared to the average performance of all other firms in the same industry (industry average performance).

H1b: IT innovative firms have lower cost ratios when compared to the average performance of all other firms in the same industry (industry average performance).

Adjusting for Prior Year Performance

The "halo effect" test includes two regression models, as described by Santhanam and Hartono (Santhanam and Hartono, 2003). The first regression model involves regressing prior year's performance on current year's financial performance. The second regression model involves extending the first model by adding a dummy variable, that is, 1 for the innovative firms and 0 for the matching control firms. The two models are as follows:

$$FP_t = \beta_0 + \beta_1 FP_{(t-1)} \quad (1)$$

$$FP_t = \alpha_0 + \alpha_1 FP_{(t-1)} + \alpha_2 D \quad (2)$$

where FP denotes each financial performance measure, t for the time period, year in this case, β_0 and α_0 are intercepts, β_1, α_1, and α_2 represent the regression coefficients, and D is a binary variable (0, 1). If α_2 is significantly different from 0, it means that the IT innovation has a significant impact on performance after adjusting for the prior year's performance. We would expect to see α_2 to be positive for the profit ratios and negative for the cost ratios. Thus, we propose the following hypotheses:

H2a: IT innovative firms have higher profit ratios when compared to the average performance of all other firms in the same industry after adjusting for prior year's financial performance.

H2b: IT innovative firms have lower cost ratios when compared to the average performance of all other firms in the same industry after adjusting for prior year's financial performance.

Environmental Consciousness

Although prior research is mixed, more recent research shows a positive relationship between firm performance and environmental consciousness. Therefore, we would expect higher financial performance for the innovative firms that are more environmentally conscious, than those firms that are less conscious about the environmental issues. We used four categories to determine the degree of environmental consciousness: participation in ISO 14001 Certification and/or Standards, level of environmental consciousness displayed on the firm's website, participation in the Environmental Protection Agency (EPA) Performance Track program, and recognition by *Business Ethics* Magazine as one of the 100 Best Corporate Citizens for the years from 2001 to 2006 (Business Ethics, 2009). These criteria will be discussed in a later section. We propose the following hypotheses:

H3a: Environmentally conscious IT innovative firms have higher profit ratios when compared to those firms that are less environmentally conscious.

H3b: Environmentally conscious IT innovative firms have lower cost ratios when compared to those firms that are less environmentally conscious.

The research model is shown in Figure 1.

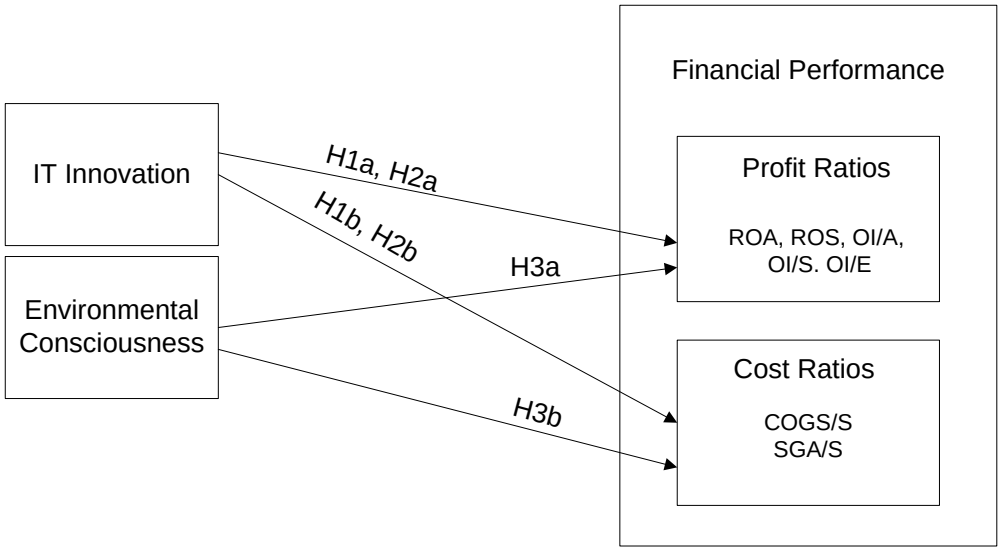

Figure 1. Research Model

RESEARCH METHODOLOGY

We employed the "matched sample comparison group" methodology to investigate the impact of organizational IT innovation on firm performance (hypotheses 1a thru 2b). As such, we used paired samples (a treatment sample and control sample) and compared the differences of measurements between two matching samples. We only employed IT innovative firms in the treatment sample to test hypothesis 3a and 3b.

The treatment sample represented an IT innovative firm, while the control sample represented a set of firms matched to the treatment sample. This approach not only enabled us to compare the difference in performance between IT innovative firms and their corresponding control firms but also enabled us to compare our findings with previous studies that used the same approach (Zhuang, 2005; Bharadwaj, 2000; Santhanam & Hartono, 2003).

Data Sources and Sample Selection

Our initial data source was *Information Week (IW) 500* annual survey reports. Since 1998, *IW* has provided an annual report on the top 500 most innovative U.S. organizations of information technologies. This report focuses on IT innovation, rather than simply the amount spent on IT. From the IW 500 companies, the top 100 companies are selected as the "leaders" which have improved in business process efficiencies by increasing automation, improving data integration, and embracing innovation. The actual criteria for defining the technology innovative company changes from year to year, based on input from the technology innovative candidates. For example, the selected IT innovative firms in the IW 2005 annual survey improved organizational performance by using IT to accomplish tasks such as increasing automation, improving data integration between systems or departments, and/or reengineering existing applications (Cuneo, 2005). Conversely, the leading 2006 technology innovators focused on operations and improved communication and access to employees, customers, and suppliers (Chabrow, 2006). We also used *Compustat*, which provides financial data for the selected innovative companies. Both *IW 500 reports* and *Compustat* have been used in numerous studies (Bharadwaj, 2000; Lichtenberg, 1995; Kudyba & Diwan, 2002; Shao & Lin, 2002) and the validity of data has been tested by previous researchers (Shin, 2007; Lichtenberg, 1995). In this study, we used both IW 500 and IW 100 firms (the 100 best of the IW 500) to determine if the findings from both datasets are consistent. Detailed selection procedures for our sample are as follows:

Treatment Sample

From the IW 500 firms, we selected all firms that were identified as IT innovators for five or more years in the six year period from 2001 to 2006. Of these, 100 firms were identified each of the six years, and 97 were identified in five of the six years, yielding an initial sample size of 197 firms. We retrieved financial data for these firms for years 2000 to 2005 from *Compustat*, due to the timing difference of the IW 500 annual report. Since *Compustat* provides information only on public firms, private firms were excluded from the sample. Firms with too many missing data were also excluded. As a result, 142 treatment firms were selected for Dataset 1 (IT innovators in IW 500).

Since previous studies relied upon only the top 100 IT leaders, we also sampled the leader firms that were selected as the top 100 firms for at least three or more years in the same six year period as IW 500 firms. After private firms and firms with missing data were excluded, a treatment firm sample of 56 was included in Dataset 2 (IT innovators in IW 100). A summary of sample size by the dataset is shown in Table 3.

Table 3. Sample Size by Dataset

Data	Sample Size (firms)
Dataset 1 (IW 500)	142
Dataset 2 (IW 100)	56

Control Sample (used in testing hypotheses 1a to 2b)

The control sample matched each treatment sample group by industry. The sampled set represents a set of industry benchmark firms using a four-digit standard industrial classification (SIC) code of the treatment firm to identify all the firms operating in the same industry. The first two-digit of a SIC code provides a general identification of a

major industry or business, while the last two-digit provides a more specific classification of a product or service within the industry. As a result, for each treatment (innovator) firm, one or more firms were matched as the control sample. Thus, the control group includes all firms operated in the four-digit industry excluding the treatment firm. The financial data were extracted from *Compustat* for the years 2000 to 2005. We used the average performance of the matching control firms (industry average performance) as the performance of the control sample and compared it to the performance of the IT innovative firm.

Environmental Consciousness

No known entities record an organization's environmental consciousness on a large scale. Although ISO 14001 is designed to address this, certification is neither required nor monitored by the *International Organization for Standardization* (ISO) (Price, 2007). Instead, separate entities offer ISO certifications to those who seek it. When reviewing ISO certifications of the IW 100 and IW 500 IT innovative firms, we could find no evidence of some firms' participation in certification. In addition, some firms were certified, but not within the United States. Other firms expressed that they followed ISO14001 guidelines, but were not certified.

Other potential measures of environmental consciousness include environmental consciousness expressed on organizational web sites, voluntary participation in the Environmental Protection Agency (EPA) National Environmental Performance Track program, and designation as one of the 100 Best Corporate Citizens by *Business Ethics* Magazine (Business Ethics, 2009). We reviewed each of the treatment group's websites

to determine the level of environmental consciousness expressed to current and potential stakeholders. Some organizations went to great lengths to express environmental consciousness, along with their "green" activities, while others expressed little or no environmental consciousness.

The National Environmental Performance Track program is a voluntary program that promotes continuous environmental improvement through environmental management systems. It encourages organizations to achieve environmental excellence beyond their legal requirements. However, very few firms have volunteered. Although they list a membership of 547 firms, a firm is counted more than once if more than one firm location volunteers. And, some firms have as many as 30 plus volunteered locations (EPA, 2009).

Business Ethics magazine ranks company performance according to environmental, financial, governance, and social criteria (Business Ethics, 2009). The 100 highest ranked companies (referred to as Corporate Citizens) are recognized by the magazine each year. Financial information is based on shareholder return over a 3-year period. Environmental, governance, and social performance is obtained from KLD Research & Analytics, an independent researcher.

Surrogate Measure for Environmental Consciousness

The surrogate measure for environmental consciousness was based on a weighting of the 4 previously mentioned criteria: ISO 14001 participation, environmental consciousness visibility on the organization's website, voluntary participation in the EPA Performance

Track, and listing as one of the 100 Best Corporate Citizens for the years from 2001 to 2006 (Business Ethics, 2009). ISO 14001 participation and environmental consciousness were provided weights from 0 to 2, depending upon the degree of participation. Volunteering for EPA Performance Track and being listed as one of the 100 Best Corporate Citizens were weighted as either 0 or 1. Based upon these criteria, the combined environmental consciousness weights could range from 0 to 6.

If a firm held ISO 14001 Certification by at least one location in the United States, it received a weight of 2. Fifty-seven firms (40.1%) in the IW 500 dataset and 30 firms (53.6%) in the IW 100 dataset met that criteria. Some firms stated that they follow ISO 14001 standards, but did not state that they were ISO 14001 certified. Others stated that they were ISO 14001 certified, but not in the United States. They received a weight of 1. Ten firms (7.0%) in the IW 500 dataset and 3 firms (5.4%) in the IW 100 dataset fell in this category. If we could find no evidence of a firm having ISO certification, either in the United States or abroad, as well as no evidence of following IS0 14001 guidelines, it received a weight of 0.

We reviewed each of the firms' websites and gave a weight of 2 to firms with strong evidence of environmental consciousness on their website. Those with minor mention of environmental awareness received a weight of 1 and those with no mention of environmental consciousness received a weight of 0. The number of firms in each category is shown in Table 4. A few firms (8% in the IW 500 dataset and 14% in the IW 100 dataset) were listed on the EPA web site as members of the voluntary National

Environmental Performance Track program. As shown in Table 4, about 25% of the firms in the IW 500 dataset and almost 50% of the firms in the IW 100 dataset were listed as one of the 100 Best Corporate Citizens during 2001 to 2006.

We next classified firms into 3 groups, based on their composite scores. Firms that exhibited the highest degree of environmental consciousness (5 or 6 points) were classified as Group 1; firms with mid-range levels of environmental consciousness (2 to 4 points) were classified as Group 2; and firms that exhibited the lowest degree of environmental consciousness (0 or 1 point) were classified as Group 3. See Table 5 for the breakdown of firms by group.

Table 4. Breakdown of Firms by Category of Environmental Consciousness and Weights Assigned to Each Category

	ISO 14001 Certification			Web			EPA		100 Best Citizens	
Data	Yes	Follow	No	Yes	Limited	No	Yes	No	Yes	No
IW500	57	10	75	82	18	42	12	130	31	111
IW100	30	3	23	43	7	6	8	48	26	30
Weight	2	1	0	2	1	0	1	0	1	0

Table 5. Breakdown of Firms by Group

Data	Sample Size (N)	Group 1	Group 2	Group 3
IW500	142	18	75	49
IW100	56	18	26	12
Composite Score		5-6	2-4	0-1

RESULTS AND DISCUSSION OF FINDINGS

Comparison of Performance of Firms Matched by Four-Digit SIC Industry Code (Hypotheses 1a and 1b)

The paired samples t-test (parametric) and the paired samples Wilcoxon test (non-parametric) were used to test if firm performance of IT innovators was better than the average performance of matching control firms in the same industry. Thus, the one-tailed test of significance was used in calculating p-values.

Compared to the t-tests that require normality assumption, the non-parametric Wilcoxon test is known to be more powerful when the underlying distribution is not normal and less sensitive to the outliers. Thus, we used both tests on the six-year average, as reported in Table 6. The year by year results from 2000 to 2005 are shown in Appendix A-1. To be consistent with the results reported by the previous studies, a negative sign of profit ratios and a positive sign of cost ratios indicate the better performance of the IT innovative firms than the control sample.

Table 6. Matched Sample Comparison of Performance Ratios

Overall Six-Year Average Performance									
Ratio	**Group**	**IW 500**				**IW 100**			
		Mean	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.034	0.035	-9.361[a]	-8.776[a]	0.032	0.028	-6.376[a]	-5.734[a]
	Control	-0.179	-0.053			-0.153	-0.036		
ROS	Innovator	0.037	0.046	-5.111[a]	-8.826[a]	0.046	0.048	-3.562[a]	-5.743[a]
	Control	-1.661	-0.277			-1.910	-0.313		
OI/A	Innovator	0.125	0.113	-8.017[a]	-8.499[a]	0.122	0.114	-5.900[a]	-5.351[a]
	Control	-0.076	0.024			-0.057	0.024		
OI/S	Innovator	0.166	0.139	-4.763[a]	-8.992[a]	0.190	0.145	-3.287[a]	-5.930[a]
	Control	-1.330	-0.044			-1.621	-0.039		
OI/E	Innovator	64.035	35.725	-4.788[a]	-6.031[a]	68.178	51.424	-2.750[a]	-4.511[a]
	Control	34.467	13.918			38.376	16.586		
COGS/S	Innovator	0.664	0.717	3.515[a]	5.465[a]	0.620	0.83	2.492[a]	3.353[a]
	Control	1.637	0.795			1.873	0.787		
SGA/S	Innovator	0.170	0.134	7.838[a]	8.717[a]	0.189	0.149	4.952[a]	5.579[a]
	Control	0.697	0.288			0.760	0.296		

a: 1 % level

The results, based on a six-year average performance, strongly support hypotheses 1 and 2. All mean profit ratios (ROA, ROS, OI/A, OI/S, and OI/E) of the innovative firms are significantly higher than the control firms and all the mean cost ratios (COGS/S and SGA/S) of the innovative firms are significantly lower than the control firms (P-values < 0.001).

Annual comparisons (Appendix A-1) also show results similar to the six-year average. In t tests, all but three instances (operating income to employee (OI/E) in 2000, 2002, and 2003) were significantly better. In Wilcoxon tests, all but one instance (COGS/S in 2002) in IW100 data were significantly better. All ratios in IW 500 dataset were significantly better, strongly supporting hypotheses 1a and 1b.

Comparison of Performance of Firms after Adjusting for Prior Year Financial Performance (Hypotheses 2a and 2b)

We used regression analysis models (1) and (2), as in Santhanam and Hartono [19] to test for the halo effect of prior year's firm performance. Table 7 shows the results of the tests, starting from year 2001 using year 2000 as the basis of the prior year performance. As before, we used the industry matching samples for both IW500 and IW100 firms. Note that all or most measurements were statistically significant without prior year adjustment (H1a and H1b).

As shown, current year's financial performance was significantly related to prior year's financial performance. Nineteen of the 35 measures in IW 500 and 14 of the 35 measures in IW 100 of the measures showed statistically significant difference between the innovative and control firms even after adjusting for prior year's financial performance.

Statistically significant positive coefficients of the dummy variable in profit ratios and negative coefficient in cost ratios show that the innovation has a strong positive impact on firm performance even after adjusting for prior year performance. However, one coefficient, OI/E (2002) in IW 100 was significant with the opposite sign. Thus, the results are somewhat mixed and hypotheses 2a and 2b are partially supported.

Table 7. Impact of IT Innovators on Performance after Adjusting the Prior Year Performance

		Year 2001				Year 2002			
		IW 500		IW 100		IW 500		IW 100	
Ratio	**Model**	**Y2000**	**Dummy**	**Y2000**	**Dummy**	**Y2001**	**Dummy**	**Y2001**	**Dummy**
ROA	1	1.054[a]		1.191[a]		0.760[a]		0.628[a]	
	2	1.051[a]	0.002	1.237[a]	-0.032	0.676[a]	0.122[a]	0.569[a]	0.103[b]
ROS	1	0.374[a]		0.670[a]		0.939[a]		1.212[a]	
	2	0.327[a]	0.962[a]	0.597[a]	0.555	0.879[a]	0.948	1.098[b]	1.903
OI/A	1	1.053[a]		0.992[a]		0.897[a]		0.972[a]	
	2	1.041[a]	0.008	0.990[a]	0.001	0.858[a]	0.054[a]	0.904[a]	0.064
OI/S	1	0.473[a]		0.759[a]		1.074[a]		1.364[a]	
	2	0.447[a]	0.551[a]	0.749[a]	0.134	1.028[a]	0.672	1.263[b]	1.606
OI/E	1	0.905[a]		0.577[a]		0.875[a]		1.310[a]	
	2	0.897[a]	11.087[a]	0.571[a]	28.268[a]	0.870[a]	5.068	1.345[a]	-30.670[c]
COGS/S	1	0.391[a]		1.097[a]		1.162[a]		1.256[c]	
	2	0.381[a]	-0.297[b]	1.095[a]	-0.28	0.109[a]	-0.753	1.158[c]	-1.728
SGA/S	1	0.208[a]		0.168[a]		0.388[a]		0.926[a]	
	2	0.158[a]	-0.467[a]	0.138[a]	-0.351[a]	0.353[a]	-0.244[b]	0.895[a]	-0.132
		Year 2003				Year 2004			
		IW 500		IW 100		IW 500		IW 100	
Ratio	**Model**	**Y2002**	**Dummy**	**Y2002**	**Dummy**	**Y2003**	**Dummy**	**Y2003**	**Dummy**
ROA	1	0.429[a]		0.390[a]		0.545[a]		0.455[b]	
	2	0.368[a]	0.110	0.338[a]	0.079[b]	0.481[a]	0.102[a]	0.349[a]	0.122[a]
ROS	1	0.114[a]		0.044		1.083[a]		0.460[a]	
	2	0.101[a]	1.143[a]	0.026	2.361[a]	1.055[a]	0.642[c]	0.424[a]	1.178
OI/A	1	1.244[a]		0.716[a]		0.135[a]		0.597[a]	
	2	1.258[a]	-0.021	0.700[a]	0.021	0.102[a]	0.141[a]	0.543[a]	0.057[a]
OI/S	1	0.084[a]		0.040		1.103[a]		0.412[a]	
	2	0.073[a]	1.039[a]	0.025	2.145[a]	1.080[a]	0.411	0.380[a]	0.907
OI/E	1	1.075[a]		0.791[a]		1.050[a]		0.769[a]	
	2	1.081[a]	-5.451	0.790[a]	-7.408	1.053[a]	-3.859	0.766[a]	8.186
COGS/S	1	0.062[a]		0.027		1.025[a]		0.430[a]	
	2	0.056[a]	-0.687[a]	0.018	-1.491[b]	1.012[a]	-0.307	0.411[a]	-0.625
SGA/S	1	0.225[a]		0.189		0.687[a]		0.076	
	2	0.186[a]	-0.317[a]	0.125	-0.625[b]	0.546[a]	-0.453[a]	0.035	-0.590[a]

		Year 2005			
		IW 500		IW 100	
Ratio	**Model**	**Y2004**	**Dummy**	**Y2004**	**Dummy**
ROA	1	0.951[a]		1.002[a]	
	2	0.915[a]	0.043[c]	0.982[a]	

					0.017
ROS	1	0.832 [a]		0.659 [a]	
	2	0.822 [a]	0.372	0.655 [a]	0.137
OI/A	1	0.967 [a]		1.201 [a]	
	2	0.937 [a]	0.029 [b]	1.151 [a]	0.036
OI/S	1	1.078 [a]		0.924 [a]	
	2	1.078 [a]	-0.024	0.934 [a]	-0.237
OI/E	1	1.093 [a]		0.493 [a]	
	2	1.092 [a]	1.421	0.465 [a]	49.598 [b]
COGS/S	1	1.038 [a]		0.859 [a]	
	2	1.039 [a]	0.036	0.864 [a]	0.147
SGA/S	1	0.432 [a]		0.437 [a]	
	2	0.398 [a]	-0.398 [b]	0.408 [a]	-0.204 [b]

a: 1 % level b: 5% level c:10% level

Environmental Consciousness (Hypotheses 3a & 3b)

As we mentioned earlier, we used four categories of environmental criteria and classified into three groups based on the total environmental consciousness composite score. For analysis, we used the six-year average performance and ran a one-way ANOVA to compare the three groups and illustrate any significant differences in mean profit or cost ratios among the groups. Tables 8 (IW 500 IT innovative firms) and 9 (IW 100 IT innovative firms) show the means and standard deviations of the performance indicators by group. The columns with the bold letters in Tables 8 and 9 represent the highest profits or the lowest costs that indicated significance in mean profit or cost ratios among the groups.

Table 8: Means & standard deviations of Performance Indicators Grouped by Environmental Consciousness Category Using IW 500

Ratio	**Overall Six-Year Average Performance - IW 500**			
	Group 1 (N=18)	**Group 2 (N=75)**	**Group 3 (N=49)**	**F**
ROA	0.037 (0.073)	0.024 (0.064)	**0.051 (0.043)**	3.247[b]
ROS	0.035 (0.122)	0.036 (0.098)	0.042 (0.041)	0.076
OI/A	**0.141 (0.078)**	0.113 (0.060)	0.138 (0.062)	2.787[c]
OI/S	0.175 (0.116)	0.183 (0.110)	0.140 (0.131)	1.902
OI/E	60.830 (51.097)	71.560 (86.626)	53.595 (94.608)	0.653
COGS/S	**0.567 (0.208)**	0.654 (0.194)	0.710 (0.190)	3.714[b]
SGA/S	0.258 (0.158)	0.164 (0.151)	**0.151 (0.131)**	3.785[b]

b: 5% level c:10% level

Table 9: Means & standard deviations of Performance Indicators Grouped by Environmental Consciousness Category Using IW 100

Ratio	Overall Six-Year Average Performance - IW 100			
	Group 1 (N=18)	**Group 2 (N=26)**	**Group 3 (N=12)**	**F**
ROA	0.038 (0.075)	0.015 (0.074)	0.060 (0.042)	1.804
ROS	0.036 (0.121)	0.045 (0.105)	0.061 (0.053)	0.208
OI/A	0.135 (0.084)	0.097 (0.069)	0.158 (0.116)	2.350
OI/S	0.173 (0.132)	0.220 (0.170)	0.159 (0.120)	0.896
OI/E	60.528 (49.576)	**92.883 (95.455)**	38.323 (30.781)	2.578[c]
COGS/S	0.568 (0.215)	0.622 (0.239)	0.694 (0.232)	1.071
SGA/S	0.259 (0.152)	0.160 (0.175)	**0.147 (0.142)**	2.519[c]

c:10% level

As shown in Table 8, the group means of ROA, OI/A, COGS, and SGA/S differed significantly in the IW 500 dataset. Group 1 (the most environmentally conscious group) had a significantly higher OI/A and significantly lower COGS/S than the other groups. However, Group 3 (the least environmentally conscious group) had a significantly higher profit ratio (ROA) and lower cost ratio (SGA/S) than Groups 1 and 2.

In the IW 100 dataset (Table 9), Group 2 had a significantly higher OI/E than other groups and Group 3 had a significant lower COGS/S than the other groups. For other performance indicators in the IW 100 datasets, no significant differences among groups were noted. Note that Group 1 did not have any significant high mean profit or low mean cost ratios than the other groups. In this dataset, groups 2 and 3 tended to have higher mean profit and lower mean cost ratios. These results are contrary to our expectation. It does not pay for IT innovative firms to "go green." Thus, hypotheses 3a & 3b are not supported.

Summary of Results and Discussion

The results of our study are summarized in Table 10. As shown, the results for both datasets (the IW500 firms (dataset 1) and IW 100 firms (dataset 2) are similar.

Innovative firms perform significantly better non-innovative firms that operate in the same industry (H1a and H1b). For most indicators, performance of innovative firms was higher than the industry average, even after adjusting for the halo effect of prior year performance (H2a and H2b). Current year's firm performance was strongly related to prior year's firm performance.

The results of our study for the impact of environmental consciousness on performance are mixed. The environmentally conscious innovative firms performed better than those that are less conscious, but only in a few cases. In other cases, less environmentally conscious IT innovators outperformed the environmentally conscious innovators. The results of our study are summarized in the Table 10.

Table 10: Summary of Results

Hypothesis		Results using IW 500	Results using IW 100
H1a	The IT innovative firms have higher profit ratios when compared to the average performance of all other firms in the same industry.	Strongly Supported	Strongly Supported
H1b	The IT innovative firms have lower cost ratios when compared to the average performance of all other firms in the same industry	Strongly supported	Strongly supported
H2a	The IT innovative firms have higher profit ratios when compared to the average performance of all other firms in the same industry after adjusting for prior year's financial performance.	Partially supported	Partially supported
H2b	The IT innovative firms have lower cost ratios when compared to the average performance of all other firms in the same industry after adjusting for prior year's financial performance.	Partially supported	Partially supported
H3a	Environmentally conscious IT innovative firms have higher profit ratios when compared to those firms that are less environmentally conscious	Not supported	Not supported
H3b	Environmentally conscious IT innovative firms have lower cost ratios when compared to those firms that are less environmentally conscious	Not supported	Not supported

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

This study revisited the impact of IT innovation on firm performance and tested the robustness of the organizational innovation theory. Using the most current dataset, this study compared performance of IT innovators with average industry performance and found, as with prior studies of earlier years, that IT innovative firms outperformed other firms in their industry. While environmental performance is a social responsibility, it does not show clear evidence that "going green" actually help achieve higher profits. We are not encouraging IT innovative firms to disregard environment performance. However, since ISO 14001 certification is a costly, time-consuming process, it may be more profitable for them to follow ISO 14001 guidelines, yet invest in IT to reduce waste, rather ISO 14001 certification.

Limitations and Future Research

All firms in our study were "large" due to the fact that only firms with at least $500 million in revenue are invited to participate in the *Information Week* survey. Although one could argue that firm size impacts performance, smaller firms are often able to act more quickly to innovative opportunities (Salavou et al., 2004). Thus, they may actually exhibit greater performance than large firms. Further research using longitudinal data including control firms with a broader range of firm size could provide further insight toward innovation theory. Also, very little IT innovation or investment research has been conducted outside the United States at either firm (Salavou et al, 2004; Tam, 1998) or national (Park et al., 2007) levels. We also noted that several firms in our study were ISO14001 certified in countries outside the United States, but not within the United States. We encourage researchers to focus more on global settings. What does, or does

not, work in the United States does not necessarily apply to other countries with different demographics, goals, and economies. Finally, further research investigating the impact of environmental performance on profits based on industry may be interesting since some industry sectors (i.e. mining) produce more waste than others (i.e. service) and thus, it might suggest additional insight on this topic.

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APPENDIX A-1

Table A-1. Year to Year Matched Sample Comparison by Industry of Performance Ratios

Year 2000									
		IW 500				IW 100			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.050	0.047	-9.490[a]	-7.198[a]	0.042	0.034	-6.065[a]	-4.674[a]
	Control	-0.138	-0.055			-0.144	-0.055		
ROS	Innovator	0.053	0.047	-4.233[a]	-6.706[a]	0.055	0.050	-4.284[a]	-4.641[a]
	Control	-1.249	-0.062			-1.083	-0.173		
OI/A	Innovator	0.144	0.133	-8.879[a]	-6.334[a]	0.129	0.132	-5.812[a]	-4.625[a]
	Control	-0.036	0.025			-0.036	0.019		
OI/S	Innovator	0.173	0.150	-4.350[a]	-6.216[a]	0.191	0.152	-3.378[a]	-4.666[a]
	Control	-1.237	0.011			-1.194	0.001		
OI/E	Innovator	59.853	36.389	-4.501[a]	-3.487[a]	64.510	42.454	1.017	-2.610[a]
	Control	35.861	14.412			49.534	14.614		
COGS/S	Innovator	0.673	0.718	2.838[a]	4.416[a]	0.635	0.663	2.033[b]	2.463[b]
	Control	1.508	0.744			1.257	0.715		
SGA/S	Innovator	0.156	0.134	4.170[a]	8.842[a]	0.172	0.162	2.716[a]	6.020[a]
	Control	0.713	0.274			0.921	0.286		
Year 2001									
		IW 500				IW 100			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.016	0.027	-7.238[a]	-8.097[a]	-0.003	0.022	-4.148[a]	-4.544[a]
	Control	-0.198	-0.053			-0.201	-0.050		
ROS	Innovator	0.014	0.036	-5.228[a]	-8.293[a]	-0.002	0.041	-2.890[a]	-3.997[a]
	Control	-1.392	-0.132			-1.216	-0.132		
OI/A	Innovator	0.121	0.117	-6.853[a]	-8.186[a]	0.113	0.119	-5.037[a]	-4.650[a]
	Control	-0.081	0.025			-0.051	0.025		
OI/S	Innovator	0.157	0.132	-4.905[a]	-8.145[a]	0.175	0.140	-2.889[a]	-4.674[a]
	Control	-1.008	-0.027			-0.979	-0.030		
OI/E	Innovator	57.184	32.450	-6.040[a]	-5.807[a]	61.201	48.165	-5.414[a]	-4.665[a]
	Control	24.471	11.829			24.248	12.249		
COGS/S	Innovator	0.670	0.724	3.408[a]	4.457[a]	0.639	0.679	2.037[b]	2.317[b]
	Control	1.281	0.743			1.337	0.723		
SGA/S	Innovator	0.175	0.143	5.008[a]	8.597[a]	0.185	0.170	3.842[a]	5.555[a]
	Control	0.717	0.277			0.633	0.287		
Year 2002									
		IW 500				IW 100			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.021	0.029	-7.140[a]	-8.124[a]	0.018	0.019	-4.708[a]	-5.041[a]
	Control	-0.246	-0.056			-0.196	-0.033		
ROS	Innovator	0.012	0.033	-2.661[a]	-7.999[a]	0.028	0.038	-1.626[c]	-4.625[a]
	Control	-2.171	-0.105			-3.154	-0.082		
OI/A	Innovator	0.118	0.107	-7.244[a]	-7.947[a]	0.113	0.095	-4.452[a]	-4.894[a]
	Control	-0.109	0.025			-0.100	0.025		
OI/S	Innovator	0.162	0.133	-2.334[b]	-7.630[a]	0.185	0.135	-1.547[c]	-4.788[a]
	Control	-1.707	0.033			-2.826	0.057		
OI/E	Innovator	54.783	31.213	-5.716[a]	-6.105[a]	61.586	37.813	0.920	-4.404[a]
	Control	21.105	9.682			43.070	9.651		
COGS/S	Innovator	0.662	0.718	1.838[b]	4.043[a]	0.621	0.675	1.296	2.691[a]
	Control	2.092	0.772			3.113	0.736		
SGA/S	Innovator	0.177	0.138	4.171[a]	8.367[a]	0.194	0.150	2.599[a]	5.025[a]
	Control	0.612	0.251			0.718	0.266		
Year 2003									
		IW 500				IW 100			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**

ROA	Innovator	0.032	0.031	-6.355[a]	-7.200[a]	0.025	0.026	-4.095[a]	-4.282[a]
	Control	-0.176	-0.012			-0.127	0.000		
ROS	Innovator	0.035	0.045	-4.254[a]	-7.301[a]	0.043	0.045	-2.977[a]	-5.123[a]
	Control	-1.331	-0.032			-2.402	-0.038		
OI/A	Innovator	0.117	0.102	-4.298[a]	-7.320[a]	0.111	0.089	-4.408[a]	-4.462[a]
	Control	-0.149	0.026			-0.059	0.025		
OI/S	Innovator	0.164	0.132	-4.437[a]	-8.106[a]	0.191	0.138	-3.048[a]	-5.433[a]
	Control	-1.013	0.022			-2.029	0.031		
OI/E	Innovator	59.639	29.779	-3.916[a]	-4.844[a]	66.665	42.600	1.194	-3.402[a]
	Control	28.337	13.233			44.636	15.360		
COGS/S	Innovator	0.666	0.721	3.032[a]	4.230[a]	0.608	0.677	2.264[b]	3.124[a]
	Control	1.434	0.762			2.144	0.726		
SGA/S	Innovator	0.170	0.135	6.265[a]	8.857[a]	0.201	0.166	2.314[b]	5.106[a]
	Control	0.569	0.302			0.893	0.319		
Year 2004									
		IW 500				**IW 100**			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.042	0.042	-7.250[a]	-7.068[a]	0.047	0.037	-5.189[a]	-5.221[a]
	Control	-0.158	-0.018			-0.128	-0.008		
ROS	Innovator	0.053	0.054	-4.065[a]	-7.338[a]	0.073	0.060	-2.766[a]	-5.280[a]
	Control	-2.014	-0.077			-2.142	-0.067		
OI/A	Innovator	0.123	0.110	-7.402[a]	-6.920[a]	0.122	0.105	-5.205[a]	-4.813[a]
	Control	-0.045	0.025			-0.028	0.022		
OI/S	Innovator	0.172	0.139	-4.101[a]	-7.455[a]	0.200	0.143	-2.866[a]	-5.531[a]
	Control	-1.494	-0.009			-1.551	-0.006		
OI/E	Innovator	69.804	36.803	-3.735[a]	-4.158[a]	72.603	57.259	-1.774[b]	-3.760[a]
	Control	40.845	14.335			47.543	17.494		
COGS/S	Innovator	0.657	0.713	3.023[a]	3.845[a]	0.603	0.664	2.257[a]	3.018[a]
	Control	1.752	0.729			1.859	0.716		
SGA/S	Innovator	0.172	0.131	5.310[a]	8.857[a]	0.198	0.169	3.248[a]	5.245[a]
	Control	0.827	0.289			0.797	0.333		
Year 2005									
		IW 500				**IW 100**			
Ratio	**Group**	**Mean**	**Median**	**T**	**Z**	**Mean**	**Median**	**T**	**Z**
ROA	Innovator	0.048	0.048	-6.408[a]	-6.638[a]	0.060	0.045	-4.992[a]	-5.588[a]
	Control	-0.181	-0.008			-0.129	0.007		
ROS	Innovator	0.058	0.058	-3.539[a]	-6.208[a]	0.076	0.076	-2.348[b]	-5.229[a]
	Control	-2.040	-0.025			-1.512	-0.040		
OI/A	Innovator	0.129	0.113	-7.764[a]	-6.212[a]	0.133	0.119	-5.337[a]	-5.204[a]
	Control	-0.059	0.031			-0.076	0.030		
OI/S	Innovator	0.173	0.142	-3.397[a]	-6.455[a]	0.202	0.166	-2.244[b]	-5.783[a]
	Control	-1.623	0.039			-1.196	0.039		
OI/E	Innovator	78.082	39.100	-4.275[a]	-3.796[a]	84.335	68.805	-3.299[a]	-4.731[a]
	Control	43.898	16.244			23.076	20.549		
COGS/S	Innovator	0.660	0.717	2.594[a]	4.237[a]	0.611	0.681	1.764[b]	2.937[a]
	Control	1.791	0.730			1.550	0.730		
SGA/S	Innovator	0.168	0.134	3.899[a]	8.845[a]	0.187	0.156	3.921[a]	5.449[a]
	Control	0.813	0.284			0.636	0.297		

a: 1 % level b: 5% level c:10% level